# A Novel Fabrication of $Si_3N_4$ Micromesh Spider Web Bolometer (MSWB) Using Deep Trench Etching on SOI Wafer.

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Bolometers are used for measurement of tiny amounts of radiant energy caused from light waves to microwaves. The sensitivity of a bolometer can be improved by reducing its base temperature to increase the sensitivity of the thermometer. Sub-millimeter wave bolometers have fabricated and achieved a steady increase in sensitivity at colder base temperature operation over the past decade. In this research, we have fabricated and developed extremely sensitive $Si_3N_4$ micromesh spider web bolometer (MSWB) for sub-milimeter astrophysics using microelectromechanical system (MEMS). We use silicon-on-insulator (SOI) bonded wafer, which has 2 μm of top silicon layer, 1 μm of $SiO_2$ insulating layer, and 350 μm of bottom silicon layer, to fabricate the MSWB. Using a deep trench reactive ion etching (RIE) from bottom silicon to insulating layer, followed by wet etching to remove $SiO_2$, 151 arrays of polygonal spider web meshes were formed on the 4" SOI wafer. We also observed that the deep trench etching results in less surface roughness and higher conductivity in the silicon nitride supports. To achieve the best accuracy performance, e-beam lithography is also employed to form contact pad layer. Various thickness of Au deposited layer using photolithography processes are used to form absorber for optimal infrared absorption and electrical lead for thermal conductance. Another set of silicon wafer is patterned and etched to rest behind the array wafer, forming $\lambda/4$ backshorts for maximum optical efficiency.

The use of MSWB techniques in this research has improved the production of more sensitive and less noise bolometer arrays. In addition, fabricated MSWB arrays have a high absorption efficiency for sub-millimeter radiation but less physical cross section area that avoids collisions of unnecessary cosmic rays. The fabrications of various MSWB sub-millimeter arrays are under development at JPL/Caltech-NASA.